Rev 2

CREDIT FOR ACCIDENT PRESSURE IN CALCULATED NPSH FOR ECCS AND CONTAINMENT HEAT REMOVAL PUMPS

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EEB

Definition of Available NPSH

$$\text{NPSH AVAILABLE} = h_{ATM} + h_{STATIC} - h_{LOSSES} - h_{VAPOR}$$

where

h_{ATM} = pressure of containment atmosphere

h_{STATIC} = pressure due to height of water above pump suction

h_{LOSSES} = pressure losses in piping, fittings, and screens

h_{VAPOR} = vapor pressure of pumped fluid

NRC Guidance On NPSH

1970 Regulatory Guide 1.1 Guidance on NPSH

....adequate NPSH is provided to system pumps assuming maximum expected temperatures of pumped fluids and no increase in containment pressure from that present prior to postulated LOCAs.

1974 Regulatory Guide 1.82 Guidance on PWR Sump Design

The available surface area in determining the design coolant velocity [at the entrance to the sump screen] should be based on one-half of the free surface area of the ... inner screen...

NRC Guidance On NPSH (CONT.)

1981 SRP 6.2.2 Rev 4 Containment Heat Removal Systems

for BWRs: $h_{atm} = 0$
for PWRs: $h_{atm} = h_{VAPOR}$, or,
$h_{atm} = 0$

NPSH analysis will be acceptable if it is done in accordance with ...Regulatory Guide 1.1, i.e., is based on maximum expected temperature of the pumped fluid and with atmospheric pressure in containment.

SRP 6.2.2 allows overpressure credit for subatmospheric containments during the first hour following a LOCA.

NRC Guidance On NPSH (CONT.)

1985	GL 85-22	(GSI A-43) LOCA Debris Guidance h_{loss} increases No backfit; consider for modifications Regulatory Guide 1.82 Rev 1 Issued. Fibrous insulation debris should be considered as uniformly distributed over the available debris screen area Did not address containment conditions assumed in determining NPSH, only design of sumps and ECCS suction strainers

NRC Guidance On NPSH (CONT.)

1996 BULLETIN 96-03 BWR ECCS STRAINER BLOCKAGE
h_{loss} increases

Result of the 1992 Barsebäck event (strainer blockage).
BWRs should Install Suction Strainers. Results in greater pressure losses
Increased suction losses due to larger strainers and consideration of debris

NRC Guidance On NPSH (CONT.)

1997	GL 97-04	Request for information on NPSH Calculations for containment heat removal and ECCS pumps including credit for containment overpressure. BWRs and PWRs. Prompted by credit for overpressure w/o prior NRC review and approval. Reviews of all operating reactors performed. Criteria developed for the review allowed credit for containment overpressure. These criteria were not documented at this time.

NRC Guidance On NPSH (CONT.)

		All BWR NPSH calculations revised as a result of Bulletin 96-03. Some BWRs received credit for overpressure. Some BWRs licensed with credit for overpressure and the credit for overpressure was increased. Some BWRs did not need overpresssure in order to comply with Bulletin 96-03.
2003	Bulletin 2001-03	Guidance on PWR Sump Blockage Some PWR licensees may request credit for containment overpressure to compensate for higher head losses

RG 1.82 Rev 3 Guidance

ECCS and containment heat removal systems should be designed so that sufficient available NPSH is provided to system pumps *assuming maximum expected temperature and no increase in containment pressure from that present prior to LOCA*

For certain operating reactors *for which the design cannot be practicably altered*, conformance with the previous position may not be possible. *In these cases, no additional containment pressure should be included in NPSH analyses than necessary to preclude pump cavitation.*

For certain operating reactors *for which the design cannot be practicably altered*, credit may be taken for pump tests which demonstrate that a cavitating pump will continue to deliver the design basis flow rate. The time period is no longer than that of the test.

Risk Consideration

A risk calculation is performed using realistic input values and assumptions.

Vermont Yankee personnel indicate that when using realistic input and assumptions, no credit for containment overpressure is required.

Therefore, risk increase is negligible.

Risk Consideration (Cont)

A staff calculation using the VY IPE and SPAR model calculated the probability of the loss of containment accident pressure

This was determined as

(LOCA probability)(Probability of failure of containment isolation)

It was assumed that loss of overpressure is equivalent to loss of ECCS pumps and therefore core damage.

$\Delta CDF = 1.3E\text{-}07 = \Delta LERF$

THIS IS SMALL AND ACCEPTABLE ACCORDING TO RG 1.174

Proposed Modified Position

Credit for overpressure is allowed when a conservative calculation demonstrates that sufficient containment pressure is available

No test of "necessity" or specific cause of the NPSH deficiency is part of the criteria for allowing credit for containment overpressure.

No limit is placed on the amount of pressure that may be assumed available as long as the pressure is determined conservatively.

Plan For Re-evaluating Credit For Containment Accident Pressure

1. Withdraw RG 1.1

2. Modify RG 1.82 Rev 3 to reflect the modified position

3. Modify SRP 6.2.2 to reflect modified position